

Acronym: SAMS-II

Title: Space Acceleration Measurement System-II

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Developer(s):

Glenn Research Center, Cleveland, OH
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Sponsoring Agency: National Aeronautics and Space Administration (NASA)

Increment(s) Assigned: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Brief Research Summary (PAO): Space Acceleration Measurement System (SAMS-II) is an ongoing study of the small forces (vibrations and accelerations) on the ISS that result from the operation of hardware, crew activities, as well as dockings and maneuvering. Results will be used to generalize the types of vibrations affecting vibration-sensitive experiments. Investigators seek to better understand the vibration environment on the space station to enable future research.

Research Summary:

- SAMS-II measures accelerations caused by vehicle, crew and equipment disturbances. These vibratory/transient accelerations occur in the frequency range 0.01 to 300 Hertz.
- Vibrations exist on the space station for a variety of reasons: equipment operation, structural motion, crew movement, and thermal expansion are but a few.
- Multiple sensors are positioned in various locations in the US Lab and are designed to measure the accelerations electromechanically.
- SAMS-II measurements help investigators characterize accelerations that influence ISS experiments. The acceleration data is available to researchers via the World Wide Web.

Exploration Talking Points: [The Space Acceleration Measurement System \(SAMS\)](#)

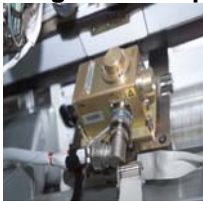
Detailed Research Description: SAMS-II measures vibrations from vehicle acceleration, systems operations, crew movements, and thermal expansion and contraction. Multiple Remote Triaxial Sensor (RTS) systems are used to monitor individual experiments requiring direct monitoring. Each RTS is capable of measuring between 0.01 Hz to beyond 300 Hz of vibration, also known as g-jitter. The RTSs consist of two components: the RTS sensor enclosure (SE) and the RTS electronics enclosure (EE). The

RTS-SE, placed as close to the experiment as possible, will translate the g-jitter into a digital signal. The RTS-EEs provides power and command signals for up to 2 RTS-SEs and receives the g-jitter data from the RTS-SEs.

The RTSs are linked together by the Interim Control Unit (ICU), which coordinates the various RTS systems being used throughout the Station. Eventually, the ICU will be replaced by a full-fledged Control Unit (CU), which will allow onboard data analysis and direct feedback and will permit crew to control the measurement parameters. The main component of the ICU is a computer. Once the ICU receives the measurements from the RTS systems, it checks the data for completeness, and the computer sends the data to the SAMS-II Ground Operations Equipment in the TeleScience Center at Glenn Research Center in Cleveland, OH.

Project Type: Payload

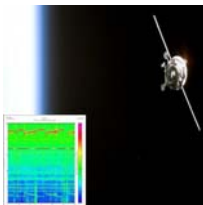
Images and Captions:



NASA Image: ISS004E8406 - SAMS sensor head mounted near top of EXPRESS rack 2 in U.S. Lab taken during Expedition 4.



NASA Image: ISS008E11936 - SAMS-II in EXPRESS rack 4 in U.S. Lab during Expedition 8.



NASA Image: ISS007E06980 - Back-dropped by the blackness of space and Earth's horizon, an unmanned Progress supply vehicle approaches the ISS during Expedition 7. Inset image shows microgravity acceleration data provided by the SAMS-II hardware during a Progress docking with ISS.

Operations Location: ISS Inflight

Brief Research Operations:

- The equipment is powered on when specific disturbances need to be analyzed and is controlled from the ground.
- The crew will install and remove sensor heads and cables to payloads.
- Crew occasionally does filter cleaning and change out.

Operational Requirements: The SAMS-II RTS is installed in Rack 1, drawers 1 and 2, away from the Active Rack Isolation System (ARIS) in Rack 2, which could cause disruptions to measurements. The ICU was installed in Rack 2, drawer 1 up through Increment 3. At the end of Increment 3, it was transferred to EXPRESS Rack 4. Once installed and activated, SAMS-II operates automatically.

Operational Protocols: Because SAMS-II measures subtle vibrations that affect only certain types of experiments, SAMS-II will not be operational all the time. Instead, it will be operated from the Glenn Research Center Telescience Support Center as needed. The ICU laptop has the capacity to save up to 10 hours of data from five sensors working at maximum frequency range. This capacity is meant to act as a backup if downlink services are interrupted.

Review Cycle Status: PI Reviewed

Category: Technology Development

Sub-Category: Characterizing the Microgravity Environment on ISS

Space Applications: The residual acceleration environment of an orbiting spacecraft in low earth orbit is a complex phenomenon. Many factors, such as experiment operation, life-support systems, crew activities, aerodynamic drag, gravity gradient, rotational effects and the vehicle structural resonance frequencies (structural modes) contribute to form the overall reduced gravity environment. Weightlessness is an ideal state, which cannot be achieved in practice because of the various sources of acceleration present in an orbiting spacecraft. SAMS-II will record acceleration disturbances caused by the ISS, its crew, and equipment. A complete understanding of the vibration environment will help researchers develop methods to minimize disturbances. It also allows other principal investigators to design their payloads with the vibration environment in mind.

Earth Applications: SAMS-II provides environmental data for scientific experiments that are conducted onboard the ISS. Any degree of acceleration disturbance can ruin their science. In fluid physics and crystal growth, SAMS-II detects the vibrational disturbances that cause the microstructures to form undefined and disfigured. The liquid - solid transition is difficult when the amount of disturbances is high.

Manifest Status: Continuing

Supporting Organization: Exploration Systems Mission Directorate (ESMD)

Previous Missions: SAMS, the precursor to SAMS-II was flown on numerous shuttle flights since STS-40, including STS-107 (Columbia) which was lost in 2003. SAMS-II has been operating on ISS since Expedition 2.

Results: One of the major goals of the International Space Station (ISS) is to provide a quiescent low-gravity environment to perform fundamental scientific research. However, small disturbances aboard the ISS impact the overall environment in which experiments are being performed. Such small disturbances need to be measured in order to assess their potential impact on the experiments. The Space Acceleration Measurement System - II (SAMS-II) is used onboard the ISS to do just that.

SAMS-II measures accelerations caused by vehicle, crew, and experiment disturbances. SAMS-II measures the vibratory/transient accelerations, which occur in the frequency range of 0.01 - 400 Hz. The sensors measure the accelerations electronically and transmit the data to the Interim Control Unit (ICU) located in the EXPRESS Rack drawer. Data is collected from all the sensors and downlinked to the TeleScience Center at Glenn Research Center. The acceleration data is processed and made available to the microgravity scientific community at [Principal Investigator Microgravity Services](#).

SAMS-II has been used in microgravity and non-microgravity modes of ISS operations to measure

vibratory acceleration disturbances. Current data indicate that ISS is not meeting its microgravity mode design requirement, and that there is no clear reduction in these disturbances during crew sleep periods (DeLombard, 2005).

SAMS-II has collected over 3.4 terabytes of acceleration data, much of which have been processed and analyzed to characterize the reduced gravity environment onboard the ISS in order to help science teams understand the ISS environment. SAMS-II, began having computer difficulties at the beginning of Expedition 12 (Oct 2005); the harddrive was replaced at the end of Expedition 14 (Apr 2007) and SAMS-II functions nominally on a as needed basis.

Results Status: Pending More Information

Results Review Status: PI Reviewed

Results Publications:

Delombard R, Hrovat K, Kelly E, Hunphreys B. Interpreting the International Space Station Microgravity Environment. 43rd AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV. Jan 10-13, 2005 ;2005-0727.

[DeLombard R, Kelly E, Hrovat K, McPherson K. Microgravity Environment on the International Space Station. 42nd AIAA Aerospace Sciences Meeting and Exhibit. Reno, NV, Jan. 5-8, 2004 ;AIAA 2004-125.](#)

Related Publications:

DeLombard R. Disturbance of the microgravity environment by experiments. Proceedings of the AIP Conference. Jan 19, 2000 ;504(1):614-618.

[Wright T. Spread and Spread Recorder An Architecture for Data Distribution. NASA Technical Memorandum. 2006 ;2006-214083.](#)

[Jules K, Hrovat K, Kelly E, McPherson K, Reckart T, Grodsinsky C. International Space Station Increment-3 Microgravity Environment Summary Report. NASA Technical Memorandum. 2002 ;2002-211693.](#)

[Jules K, Hrovat K, Kelly E, McPherson K, Reckart T. International Space Station Increment-2 Microgravity Environment Summary Report. NASA Technical Memorandum. 2002 ;2002-211335.](#)

[Jules K, Hrovat K, Kelly E, McPherson K, Reckart T. International Space Station Increment-2 Microgravity Environment Summary Report. NASA Technical Memorandum. 2002 ;2002-211335.](#)

[Jules K, Hrovat K, Kelly E. International Space Station Increment-2 Quick Look Report. NASA Technical Memorandum. 2002 ;2002-211200.](#)

Jules K, Hrovat K, Kelly E, Reckart T. International Space Station Increment 6/8 Microgravity Environment Summary Report November 2002 to April 2004. NASA Technical Memorandum. 2006 ;2006-213896.

Web Sites:

[NASA Fact Sheet](#)

[Microgravity Science Division at Glenn Research Center - SAMS-II](#)

[SpaceRef.com - End of an Era for SAMS](#)

Related Payload(s): MAMS, MACE-II, ARIS-ICE

Last Update: 02/17/2009